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제품 표준
(LTN156AT20-H01)

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대상 제품	LTN156AT20-H01		
승인정보	작성자	승인자	REV No.
	김종태 선임	양동철 수석	V03
	2012.01.03	2012.01.03	

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1. 개정 내역

개정일	Rev No.	개정자	개정 Page	개정 내용
2011.10.04	V00	김종태		최초 제정
2011.12.10	V01	김종태	P11	LVDS 입력사양
2012.02.24	V02	김종태	-	제품표준 신양식 적용 (REV002버젼)
2012.3.7	V03	김종태	-	제품 표준 신양식 (REV005버젼)

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2. 일반 개요

2.1 목적

제품 정보를 정의하고, 이를 부서간에 공유하기 위함.

2.2 관련표준

SQ00029 LCD 신뢰성 불량 판정 품질 표준

2.3 적용범위

LTN156AT20-H01 제품

2.4 제품 개요

2.4.1 개요

LTN156AT20-H01 은 비정질 실리콘(Amorphous Silicon) 박막 트랜지스터(TFT;Thin Film Transistor)를 스위칭 소자로 이용한 컬러 능동 행렬(Color active matrix) 방식의 TFT 액정 표시소자(LCD;Liquid Crystal Display)이다. 이는 TFT LCD Panel, 구동회로부와 LED를 광원으로 하는 Back light부로 구성 된다.
LTN156AT20-H01 의 대각선은 1366X768 Pixel을 포함하고 262,144의 색상을 지원한다.
그리고 최적의 시각방향은 6시 방향이다.

2.4.2 특징

① 얇고 가볍다.
② 높은 휘도 대비비, 넓은 시야각, 넓은 색표현 범위 특성
③ RoHS compliance
④ DE Only Mode
⑤ 3.3V 구동 전원

2.4.3 응용분야

① 노트북 컴퓨터용 화면 표시기

2.4.4 일반사양

(Ta=25±2 ℃), 6시 방향

항목	사양	단위	비고
환경 안전 규제	Pb Free, Halogen Free		
유효표시면적	344.232 (H) x193.536 (V)(15.6"diagonal)	mm	
표현가능색 수	262,144 색 (6bit)		
해상도	1366 x 768 (HD)	pixel	16:9
화소배열	RGB 수직 줄배열(RGB VERTICAL STRIPE)		
Pixel 크기	0.252 (H) x 0.252 (V) (TYP.)	mm	
표시모드	백색바탕모드(NORMALLY WHITE), TN Mode		
표면처리	헤이즈(Haze) 0, 강도 3H		Glare Pol
광원	W-LED (27 EA)		
백색 휘도	200 typ	cd/㎡	
Module 크기	359.5 X 223.8 Typ	mm	
두께	3.8 Max	mm	
무게	440 Max	g	
응답속도	16 Typ	ms	
소비 전력	3.6 Max (Logic + BLU, Converter 포함)	W	Mosaic PTN

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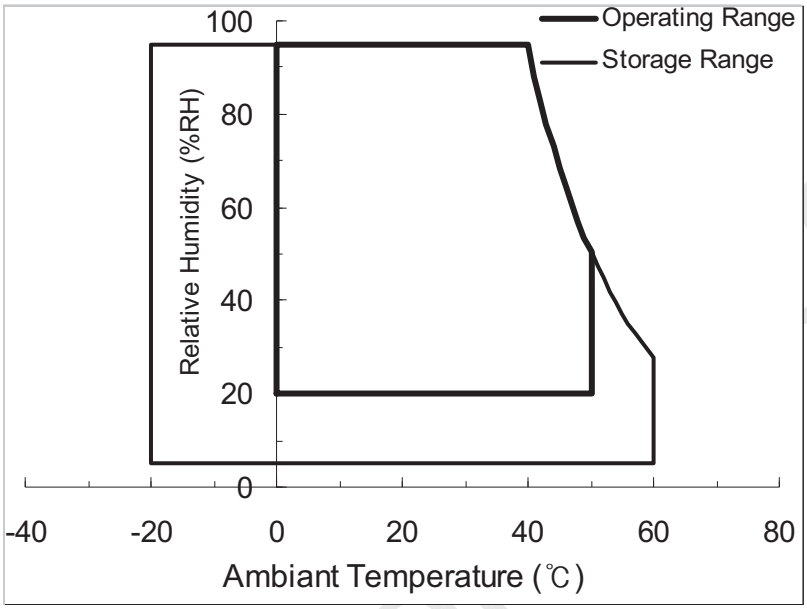
3. 절대 정격

3.1 환경 절대 정격

ITEM	SYMBOL	MIN.	MAX.	UNIT	NOTE
Storage temperature	TSTG	-20	60	℃	(1)
Operating temperature	TOPR	0	50	℃	(1)

NOTE (1) 온도와 상대습도 관계는 아래 그림에 따른다.
Ta〈40℃일때 상대습도 95%RH MAX.
Ta≥40℃일때 최대습구온도(Maximum Wet Bulb)는 39℃ 이하.



3.1.1 LCD 제품 보관 기준

ITEM	Unit	Min.	Max.
Storage Temperature	(℃)	5	40
Storage Humidity	(%rH)	35	75
Storage life	12 months		
Storage Condition	-. Prohibit direct sunlight -. Ventilation in storehouse and Control changing temperature is within limits of environment -. Put it on pallet, don't put it on floor. and store them with removing form wall. -. Don't wet Out-BOX and avoid rain. -. Without condensation. -. Etc. Avoid harmful Condition.		

3.1.2 장기 보관품 처리 기준

Long -term Storage Process	More than 3months Storage or Low temp. Delivery/under 5℃ Storage, → On the 20℃ 50%rH Condition , More than 24hr release.

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3.2 전기적 절대 정격

3.2.1 입력 전압

(VSS = 0V, VDD=3.3V)

ITEM	SYMBOL	MIN.	MAX.	UNIT	NOTE
Power Supply Voltage	VCC	VSS-0.3	VDD+0.3	V	(1)
LVDS Input Voltage	Vlvds	VSS-0.3	2.0	V	(1)
Logic Input Voltage (SCL, SDA, EN, PWM)	VLogic	VSS-0.3	VDD+0.3		
BLU 구동 전압	VBLU	VSS-0.3	26.5	V	(1)

NOTE(1) 동작온도 범위 내에서

3.3.2 ESD

항 목		인 가 조 건	동 작
ESD	Contact Discharge	150pF, 330Ω	± 8 kV
	Air Discharge	150pF, 330Ω	± 15 kV

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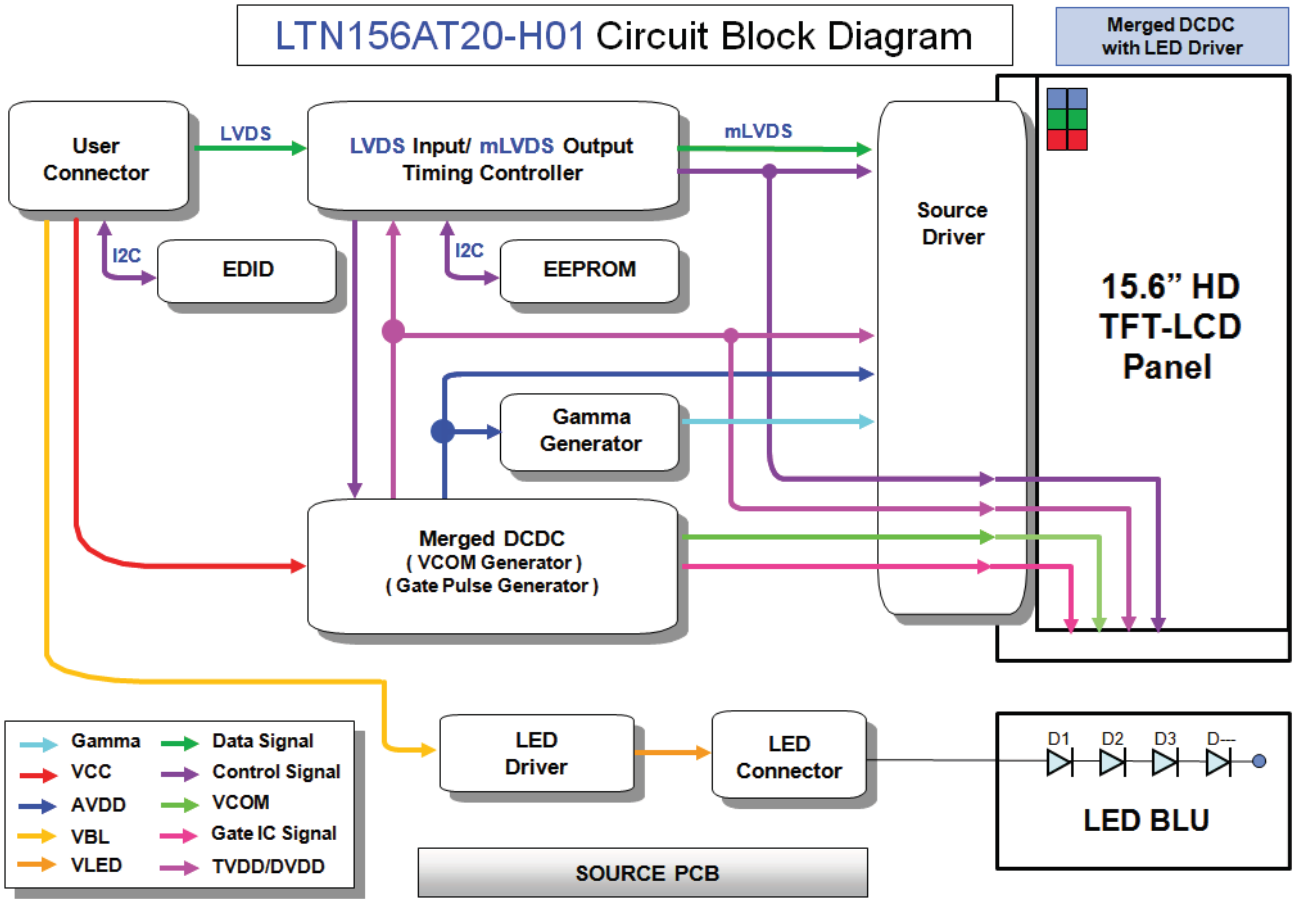
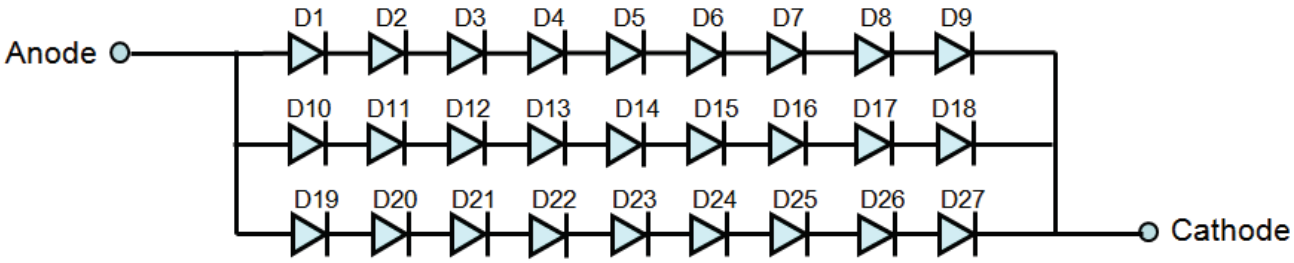
4. Block Diagram

4.1 TFT LCD Module



4.2 Back Light unit



5. 전기적 특성

5.1 TFT LCD Module

(Ta=25±2 ℃)

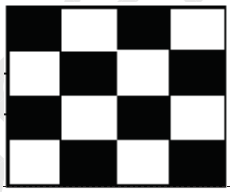
ITEM		SYMBOL	MIN.	TYP.	MAX.	UNIT	NOTE
Power Supply Voltage		VCC	3.0	3.3	3.6	V	
LVDS Impedance		Z_{LVDS}	90	100	110	Ω	(1)
G/A 입력 전압	High	VIH	0.7VDD	-	-	V	(1)
	Low	VIL	-	-	0.3VDD	V	(1)
Power Consumption	(a) White	ICC	-	220	300	mA	(2),(3)*a
	(b) Mosaic	ICC	-	220	300	mA	(2),(3)*b
	(c) Black	ICC	-	220	300	mA	(2),(3)*c
	(d) V.stripe	ICC	-	400	450	mA	(2),(3)*d
Differential input high threshold voltage		V_{TH}			100	mV	V_{CM}=1.2V
Differential input low threshold voltage		V_{TL}	-100				
Vsync Frequency		fV	-	60	-	Hz	
Main Frequency		fDCLK	-	72.33	-	MHz	-
Rush Current		IRUSH	-	-	1.5	A	(4)

NOTE (1) 디스프레이 데이터 및 타이밍 신호용 콘넥터는 연결되어 있으며,
정상적인 화면 구동을 하고 있을 것 것(V_{SS} = 0V)

(2) f_V = 60Hz, f_{DCLK} = 72.33MHz, V_{CC} = 3.3 V, DC current

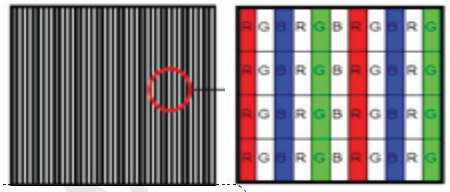
(3) 소비전력 체크패턴

(a) White Pattern



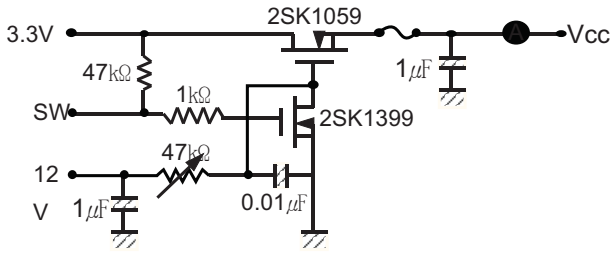
(b) Mosaic Pattern

(c) Black Pattern



(d) V.stripe Pattern

(4) 측정조건 (Vcc Rising time =470 ㎲)



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5.2 Back Light Unit

5.2.1 LED 구동 회로부

(Ta=25±2 ℃)

ITEM		SYMBOL	MIN.	TYP.	MAX.	UNIT	NOTE
Power Supply Voltage		V_{BLU}	6	12	20	V	
Input Current		I_{BLU}	–	–	300	mA	(1)
BLU 소비 전력			–	–	4.0	W	(2)
EN Control Level	ON	V_{EN}	2	3.3	5.0	V	
	OFF		–	–	0.8	V	
PWM Control Level	ON	V_{PWM}	2	3.3	5.0	V	–
	OFF		–	–	0.8	V	
External PWM Dimming Control Frequency		F_{PWM}	0.12	–	30	KHZ	
PWM Control Duty Ratio		D	0.2	–	100	%	120Hz<F_{PWM}<0.5 KHz
			0.4	–	100	%	0.5KHz<F_{PWM}<1K Hz
			0.8	–	100	%	1KHz<F_{PWM}<2KHz
			1.5	–	100	%	2KHz<F_{PWM}<5KHz
			3	–	100	%	5KHz<F_{PWM}<10K Hz
			10	–	100	%	10KHz<F_{PWM}<30 KHz
In-Rush Current		IRUSH	–	–	1.5	A	(3)
OVP 동작 전압		V_{OVP}	–		42	V	
수명			12,000			Hr	(4)

NOTE (1) Duty = 100%, V_{BLU}= 12V
(2) Converter 소비 전력 포함 , V_{BLU}= 12V.
(3) 측정 조건 – TBD
(4) Typ LED Current에서 최초 휘도의 50%가 되는 시간.

5.2.2 LED Ass'y

(Ta=25 ℃)

ITEM	SYMBOL	MIN.	TYP.	MAX.	UNIT	NOTE
LED Forward Voltage	Vf	3.0	3.2	3.4	V	(1)
LED Forward Current	If	–	25	–	mA	
사용 LED 수		–	27	–	EA	
LED 휘도		2,300	–	–	mcd	(1)

NOTE (1) If = 25mA 일때
(2) LED channel 수 = 3개 일때

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6. 입력 사양

6.1 입력 Pin 사양

Input Connector: IPEX 20455 's or Compatible

Mating Connector : 20345-#40E-## series or equivalent, LVDS Receiver: DS90CF364 or Compatible

	명칭	Full Description	Remarks
1	NC	Hot Plug Detect or No connection (optional)	
2	LCD_VCC	LCD logic and driver power	
3	LCD_VCC	LCD logic and driver power	
4	VCC_EDID	DDC power	
5	NC (WPN)	Reserved for LCD manufacturer's use (WPN)	
6	CLK_EDID	DDC clock	
7	DAT_EDID	DDC data	
8	RX0-	Negative LVDS differential data input for pixel	
9	RX0+	Positive LVDS differential data input for pixel	
10	H_GND	High Speed Ground	
11	RX1-	Negative LVDS differential data input for pixel	
12	RX1+	Positive LVDS differential data input for pixel	
13	H_GND	High Speed Ground	
14	RX2-	Negative LVDS differential data input for pixel	
15	RX2+	Positive LVDS differential data input for pixel	
16	H_GND	High Speed Ground	
17	RXC-	Negative LVDS differential clock input for pixel	
18	RXC+	Positive LVDS differential clock input for pixel	
19	LCD_GND	LCD logic and driver ground	
20	NC	No connection	
21	NC	No connection	
22	LCD_GND	LCD logic and driver ground	
23	NC	No connection	
24	NC	No connection	
25	LCD_GND	LCD logic and driver ground	
26	NC	No connection	
27	NC	No connection	
28	LCD_GND	LCD logic and driver ground	
29	NC	No connection	
30	NC	No connection	
31	BL_GND	Backlight Ground	
32	BL_GND	Backlight Ground	
33	BL_GND	Backlight Ground	
34	NC	Hot Plug Detect or No connection (optional)	
35	BL_PWM_DIM	System PWM signal input for dimming	
36	BL_ENABLE	Backligh on/off	
37	NC	APS on/off or No connection (optional)	
38	BL_PWR	Backlight power	
39	BL_PWR	Backlight power	
40	BL_PWR	Backlight power	

※ GND사양

1) High Speed Ground는 최소 1PIN이상이 wire로 연결되어 있어야 함.

2) LCD logic and driver ground는 최소 1PIN이상이 wire로 연결되어 있어야 함.

3) Backlight Ground는 최소 1PIN이상이 wire로 연결되어 있어야 함.

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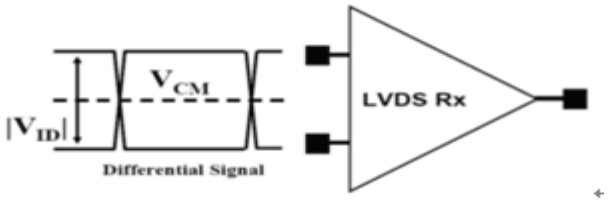
6.2 LVDS 입력 사양

6.2.1 LVDS DC 입력 사양

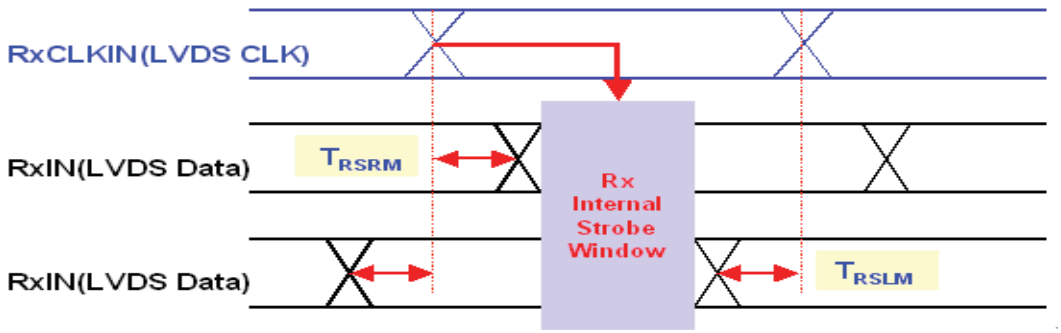
ITEM	SYMBOL	MIN.	TYP.	MAX.	UNIT	NOTE
LVDS Differential Voltage	|VID|	200	-	600	mV	
Input Common Mode Voltage	V_{CM}	0.4	-	1.8	V	



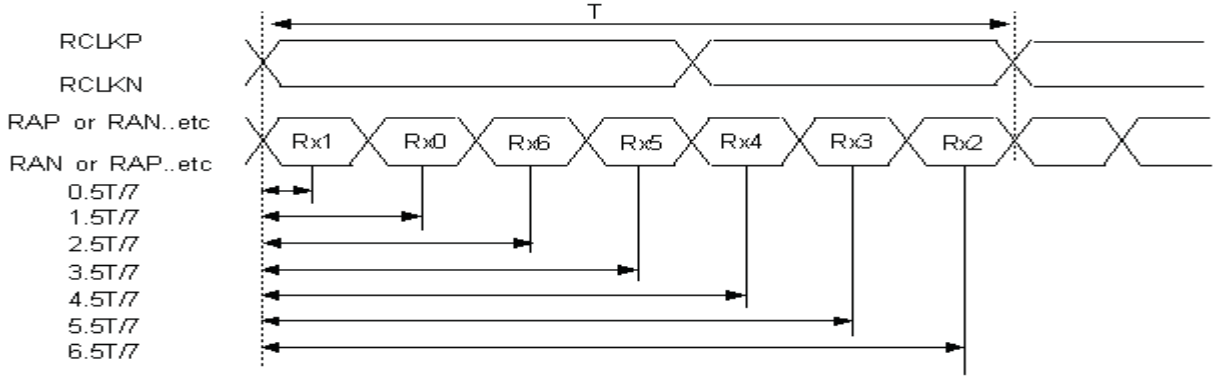
6.2.2 LVDS AC 입력 사양

ITEM		SYMBOL	MIN.	TYP.	MAX.	UNIT	NOTE
DLL Lock Time					100	μsec	
LVDS Clock Ratio		T_{OD}	-	4:3	-	-	
LVDS RX Skew(Strobe) Right Margin	85MHz	T_{RSRM}	-	-	400	ps	(1),(2)
	50MHz		-	-	700	ps	(1),(2)
LVDS RX Skew(Strobe) Left Margin	85MHz	T_{RSLM}	-400	-	-	ps	(1),(2)
	50MHz		-700	-	-	ps	(1),(2)
SSC Modulation Rate		F_{CLK_MOD}	-	-	±3	%	(3)
SSC Modulation Frequency		F_{CLK_DEV}	30	-	300	KHz	(3)

Note (1) : LVDS Receiver Skew (Strobe) Margin



Note (2) : Ideal Strobe Positions for LVDS Input



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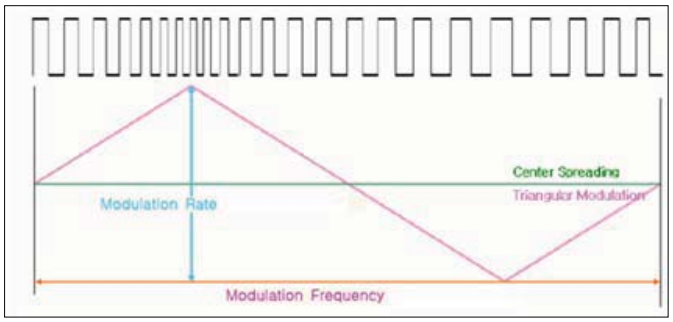
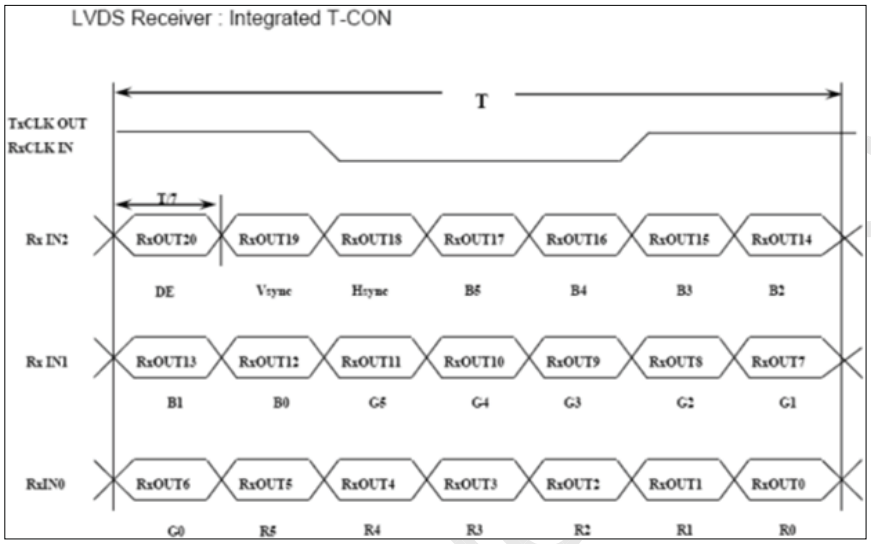
Note (3) : SSC (Spread Spectrum Clock)



6.2.3 LVDS Data format



6.3 Interface Timing (DE Only Mode)

SIGNAL	ITEM	SYMBOL	MIN.	TYP.	MAX.	UNIT	NOTE
Frame Frequency	Cycle	fV	-	60	-	Hz	-
		TV	773	790	810	lines	-
Vertical Active Display Term	Display Period	TVD	-	768	-	lines	-
	Verticle Blank Period	TVB	5	22	42	lines	-
One Line Scanning Time	Cycle	TH	1446	1526	1726	clocks	-
Horizontal Active Display Term	Display Period	THD	-	1366	-	clocks	-
		THB	80	160	360	pixels	-
Main CLK Freq.	Cycle	1/TC	66.06	72.33	83.88	MHz	-

Note (1) Test Point : CLK at LVDS Tx input terminal in system

Note (2) 동작 시 DE 신호는 항상 동일한 주기를 가져야 함.

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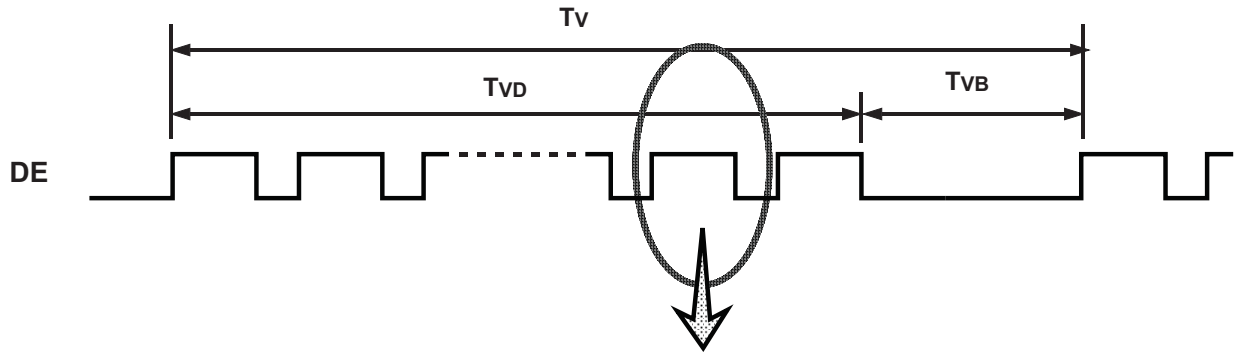

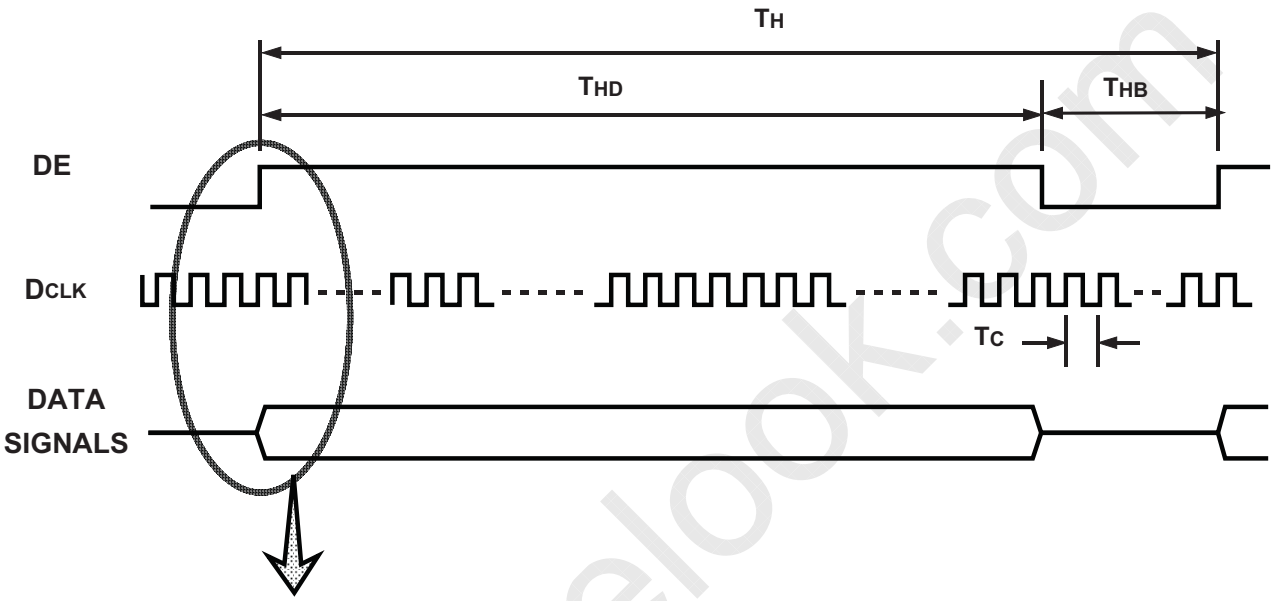

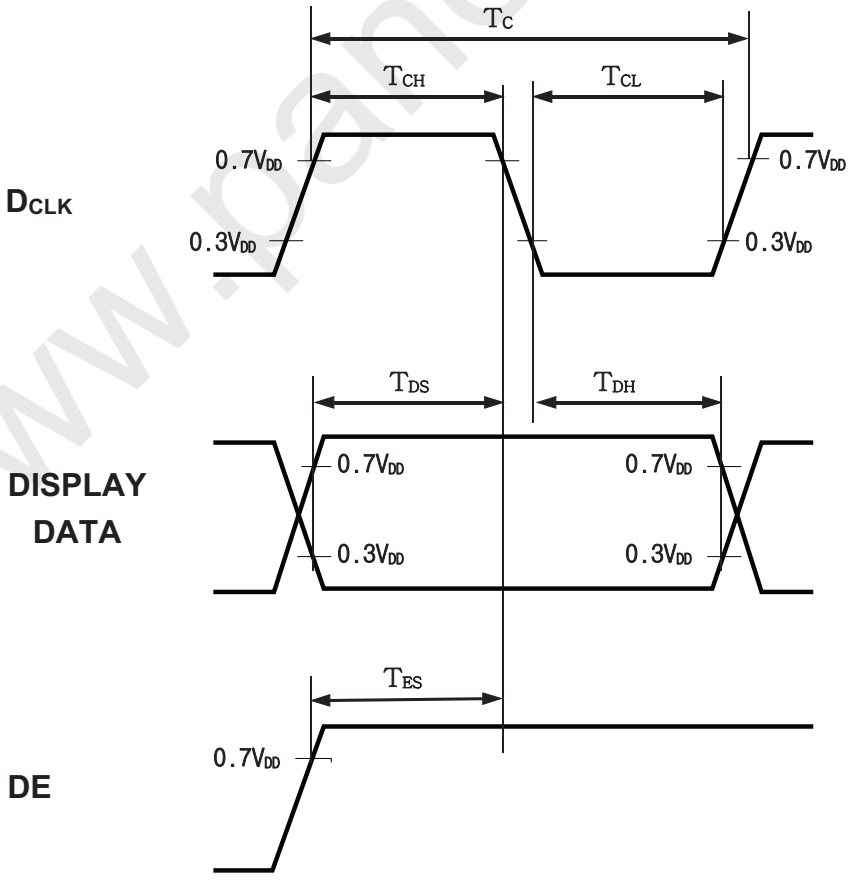

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6.4 입력신호와 표시색상과의 관계

Color & Gray scale	Data Signal																	
	R0	R1	R2	R3	R4	R5	G0	G1	G2	G3	G4	G5	B0	B1	B2	B3	B4	B5
Black	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Blue	0	0	0	0	0	0	0	0	0	0	0	0	1	1	1	1	1	1
Green	0	0	0	0	0	0	1	1	1	1	1	1	0	0	0	0	0	0
Light blue	0	0	0	0	0	0	1	1	1	1	1	1	1	1	1	1	1	1
Red	1	1	1	1	1	1	0	0	0	0	0	0	0	0	0	0	0	0
Purple	1	1	1	1	1	1	0	0	0	0	0	0	1	1	1	1	1	1
Yellow	1	1	1	1	1	1	1	1	1	1	1	1	0	0	0	0	0	0
White	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1
Black	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
			^ ^ v v						^ ^ v v						^ ^ v v			
	1	0	1	1	1	1	0	0	0	0	0	0	0	0	0	0	0	0
	0	1	1	1	1	1	0	0	0	0	0	0	0	0	0	0	0	0
Red	1	1	1	1	1	1	0	0	0	0	0	0	0	0	0	0	0	0
Black	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0
	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0
			^ ^ v v						^ ^ v v						^ ^ v v			
	0	0	0	0	0	0	1	0	1	1	1	1	0	0	0	0	0	0
	0	0	0	0	0	0	0	1	1	1	1	1	0	0	0	0	0	0
Green	0	0	0	0	0	0	1	1	1	1	1	1	0	0	0	0	0	0
Black	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0
	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0
			^ ^ v v						^ ^ v v						^ ^ v v			
	0	0	0	0	0	0	0	0	0	0	0	0	1	0	1	1	1	1
	0	0	0	0	0	0	0	0	0	0	0	0	0	1	1	1	1	1
Blue	0	0	0	0	0	0	0	0	0	0	0	0	1	1	1	1	1	1

입력신호 : 0=Low level voltage, 1=High level voltage
NOTE : MSB는 R5,G5,B5이고 LSB는 R0,G0,B0

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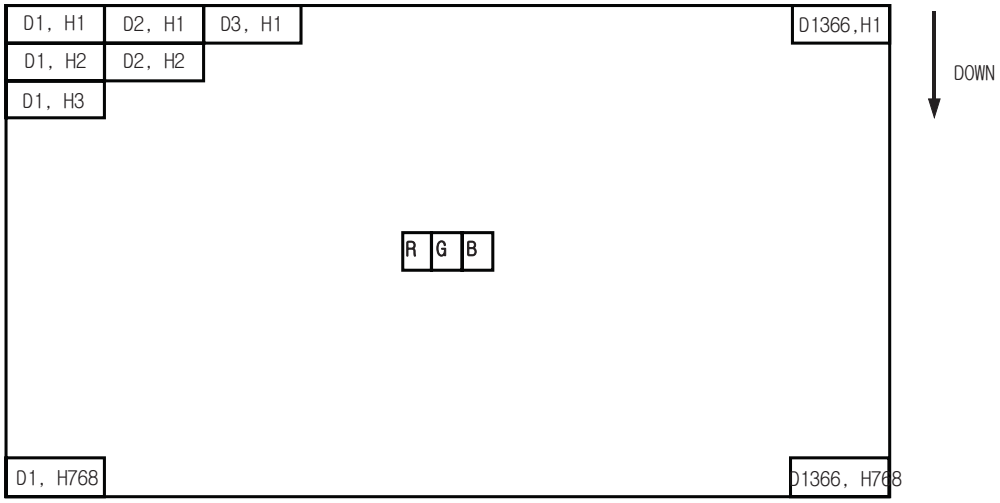
6.5 PANEL상의 화소 표시위치



NOTE : (Dn, Hm) = 오른쪽으로 n번째, 아래로 m 번째 화소

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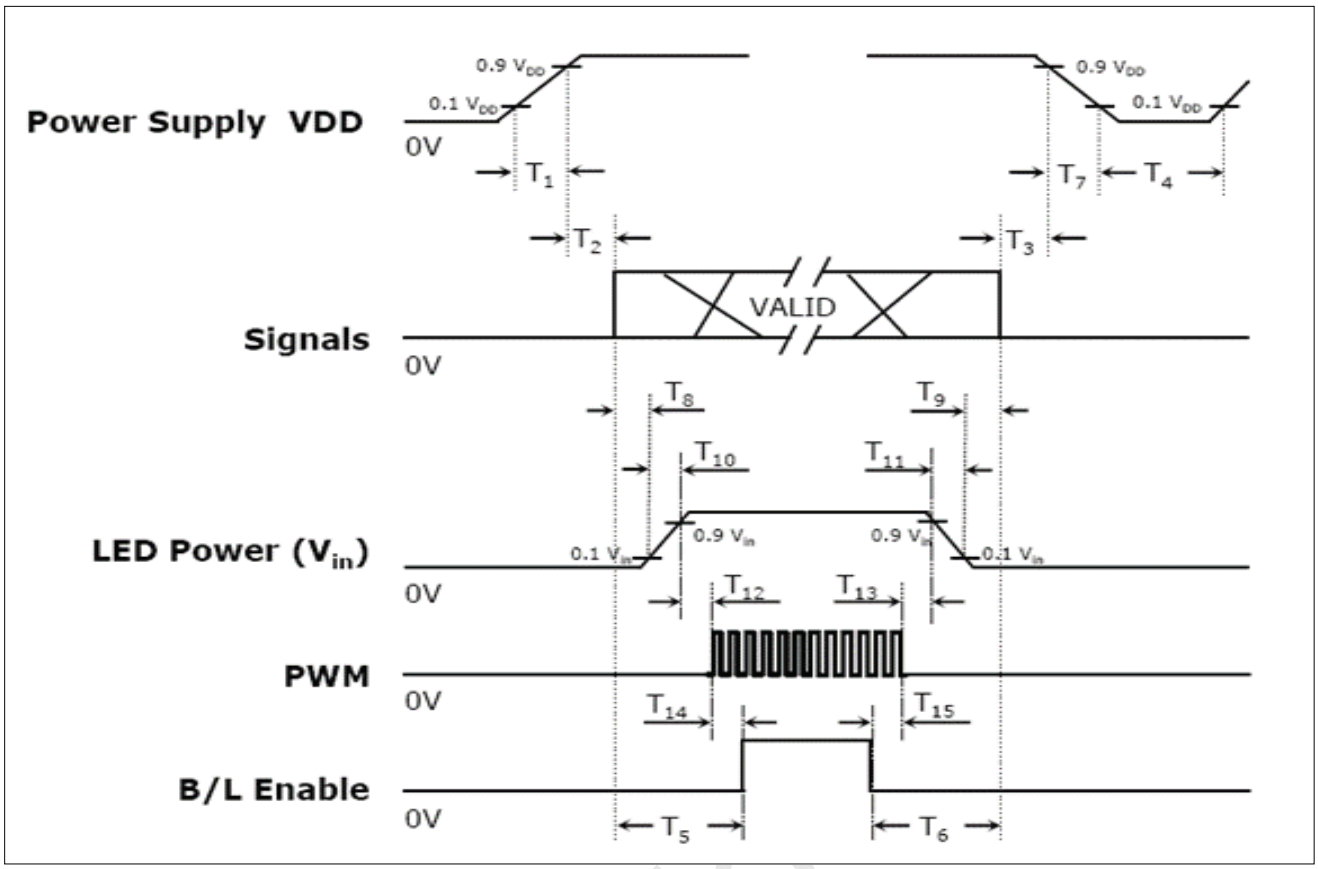
6.6 Power sequence

: Latch-up이나 LCD 모듈의 DC operation을 막기 위해 전원 온/오프 순서는 아래와 같아야 함.



Timing (ms)	Remarks
0.5< T1 ≤ 10	VDD rising time from 10% to 90% (이전과동일)
0< T2 ≤ 50	Delay from VDD to valid data at power ON (이전과동일)
0< T3 ≤ 50	Delay from valid data OFF to VDD OFF at power Off (이전과동일)
500 ≤ T4	VDD OFF time for Windows restart (이전과동일)
200 ≤ T5	Delay from valid data to B/L enable at power ON (이전과동일)
200 ≤ T6	Delay from valid data off to B/L disable at power Off (이전과동일)
0< T7 ≤ 10	VDD falling time from 90% to 10%
10< T8	Delay from valid data on to LED driver Vin rising time 10%
10< T9	Delay from LED driver Vin falling time 10% to valid data Off
0.5< T10 ≤ 10	LED Vin rising time from 10% to 90%
0.5< T11 ≤ 10	LED Vin falling time from 90% to 10%
0< T12	Delay from LED driver Vin rising time 90% to PWM ON
0< T13	Delay from PWM Off to LED driver Vin falling time 10%
0 ≤ T14	Delay from PWM ON to B/L Enable ON
0 ≤ T15	Delay from B/L Enable Off to PWM Off

NOTE

(1) 모듈에 신호를 인가하는 외부장치의 전원은 Vcc와 같아야 한다.

(2) LCD 동작 범위내에서 램프의 전압을 인가 할 것. LCD가 동작되기 전에 램프를 켜거나 램프를 끄기 전에 LCD를 끌 때, 화면이 순간적으로 백색상태가 됨.

(3) Vcc가 인가된 후 인터페이스 신호가 들어가지 않는 상태(Interface Signal High Impedance)로 장시간 두지 말 것.

(4) Power Off후 재 Power On하기 전에 제품이 완전히 방전 후 측정.

7. 광학적 특성

광특성은 Note (5)의 방법으로 암실에서 측정한다.

측정조건: Ta= 25±2℃, VCC=3.3V, fV=60㎐, fDCLK=72.33㎒, V_{BLU} = 12V, 100% Duty

ITEM		SYMBOL	CONDITION	MIN.	TYP.	MAX.	UNIT	NOTE
Contrast Ratio(5Points)		CR		500	-	-		(1),(2)의①
Response time at 25℃	Rising	TR + TF		-	16	25	ms	(1), (3)
	Falling							
Average Luminance of White(5 Points)		YL,AVE		170	200	-	cd/㎡	(2)의 ② IL=25mA
Cross Modulation		DSHA	ϕ=0 Θ=0 Viewing Normal Angle	-	-	2.0	%	(4)
색재현성		-		-	45	-	%	
Color Chromaticity (CIE 1931)	Red	RX		TYP -0.03	0.570	TYP +0.03	-	SR3로 측정 (1),(5)
		RY			0.340			
	Green	GX			0.330			
		GY			0.560			
	Blue	BX			0.160			
		BY			0.135			
	White	WX			0.313			
		WY			0.329			
Viewing Angle	Hor.	ΘL	CR≥10	40	-	-	Degrees	(1),(5)
		ΘR		40	-	-		
	Ver.	ϕH		10	-	-		
		ϕL		25	-	-		
13 Points White Variation		δW		-	-	1.6		(2)의 ③
Flicker		F	-	-	-	5.2	-	(6)

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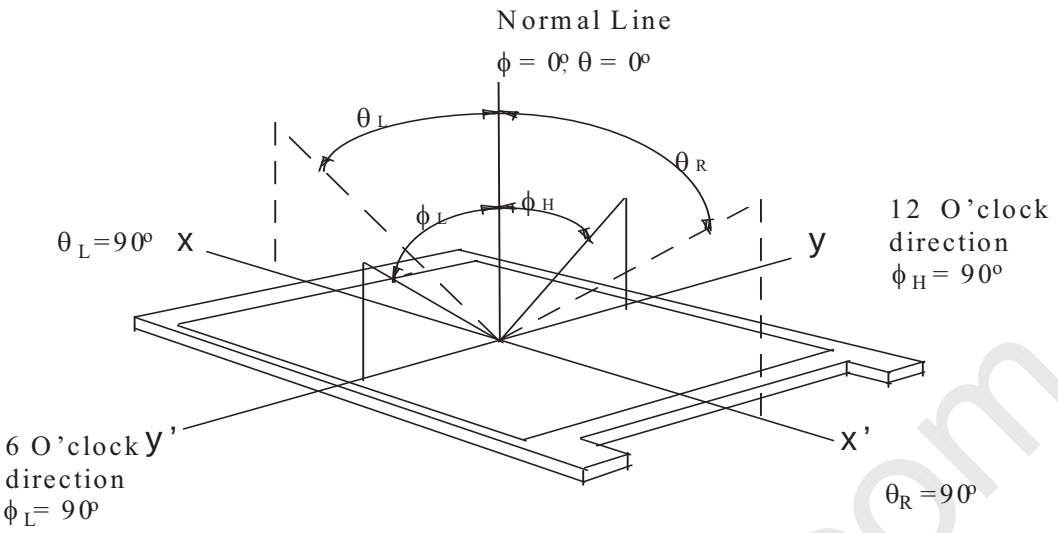
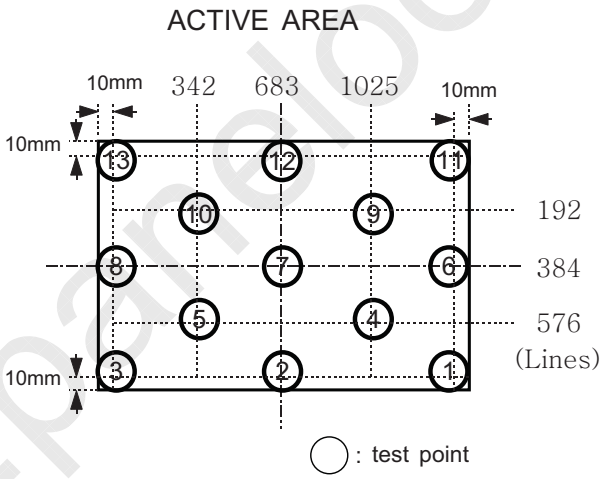
NOTE (1)

시야각(Viewing angle)의 정의 : C/R이 10이상되는 시각의 범위



NOTE (2)

측정위치 : 판넬상 측정위치는 13개 점으로 한다.



① 대비비(C/R : Contrast ratio)

: 측정위치 중앙의 5개 점에서 밝은 상태(GMAX)와 어두운 상태(GMIN)의 비로 정의.

$$C/R(n) = \frac{\text{Panel 상 위치 n에서 밝은 상태 휘도}}{\text{Panel 상 위치 n에서 어두운 상태 휘도}}$$

여기서, n은 측정위치임. (4, 5, 7, 9, 10)

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② White 평균 휘도의 정의 (YL,AVG) :

측정위치 중앙의 5개 점에서 white 휘도(YLn) 를 측정한 평균값.

$$Y_{L,AVG} = \frac{Y_{L4} + Y_{L5} + Y_{L7} + Y_{L9} + Y_{L10}}{5}$$

③ 13 point white variation(δw)측정

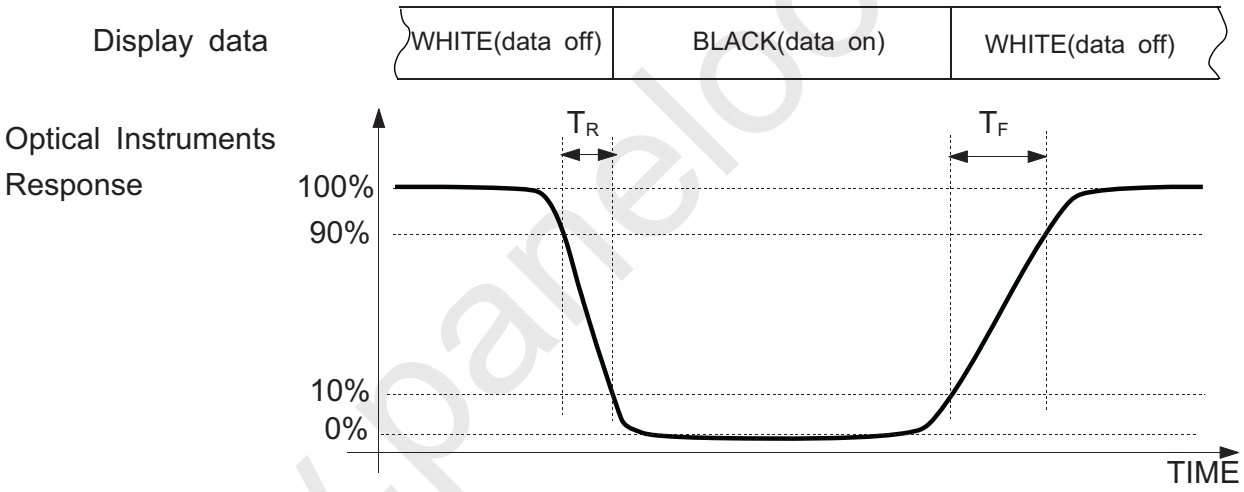
: 판넬상의 13개의 test points를 측정하여 아래식과 같이 정의(①~⑬).

$$dW = \frac{13개\ 측정값중\ 최대값}{13개\ 측정값중\ 최소값}$$

NOTE (3)

응답시간(Response time)의 정의

: 화면이 어두워 질 때와 밝아질 때에 투과율이 10%와 90%사이로 변화하는 시간의 합.(RD-80S 측정, 거리 50㎝)



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NOTE (4)

상호 혼선(Crosstalk;Cross modulation)의 정의(D_{SHA}): 화소간의 신호간섭에 의하여 대비비가 저하되는 현상.

Crosstalk 계산 방법

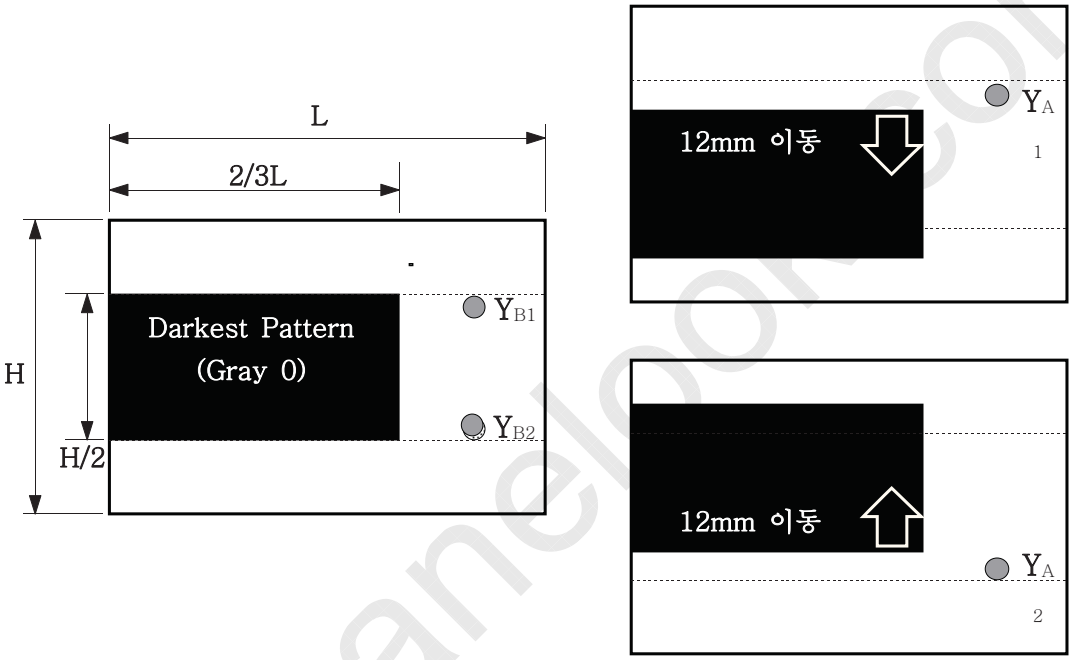
$$\text{Crosstalk Modulation Ratio}(D_{SHA}) = \frac{|Y_A - Y_B|}{Y_A} \times 100\ (\%)$$

Where

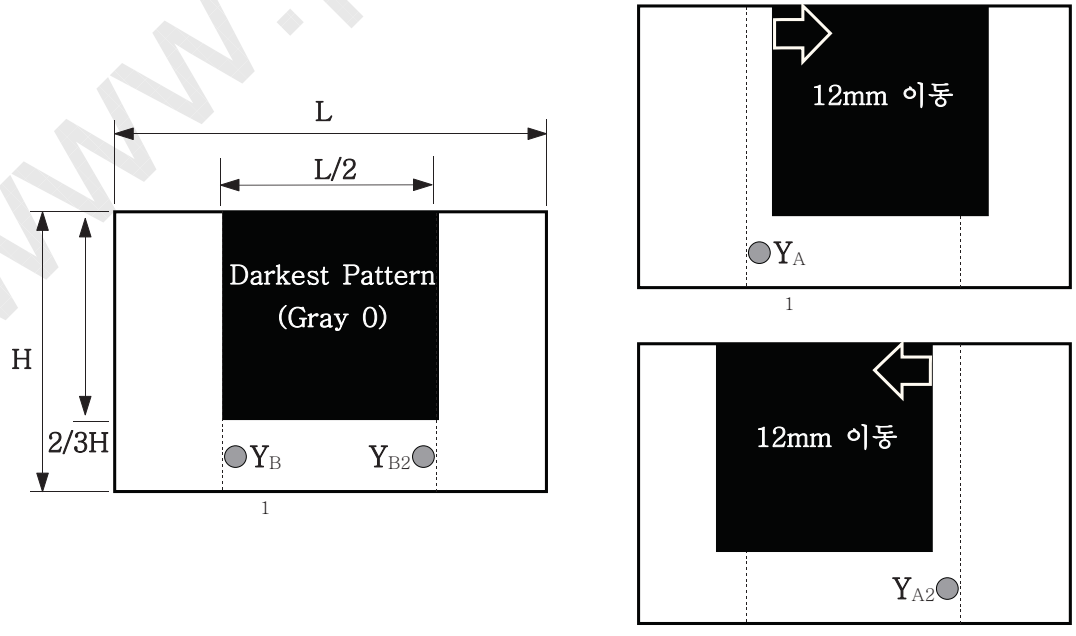
Y_A , Y_B = 측정은 2°Viewing Angle (측정 area ψ12㎜)

Black Bar 이외의 back ground pattern은 Gray 1~63 범위를 포함.

ⓐ Horizontal-Crosstalk 측정방법



ⓑ Vertical-Crosstalk 측정방법



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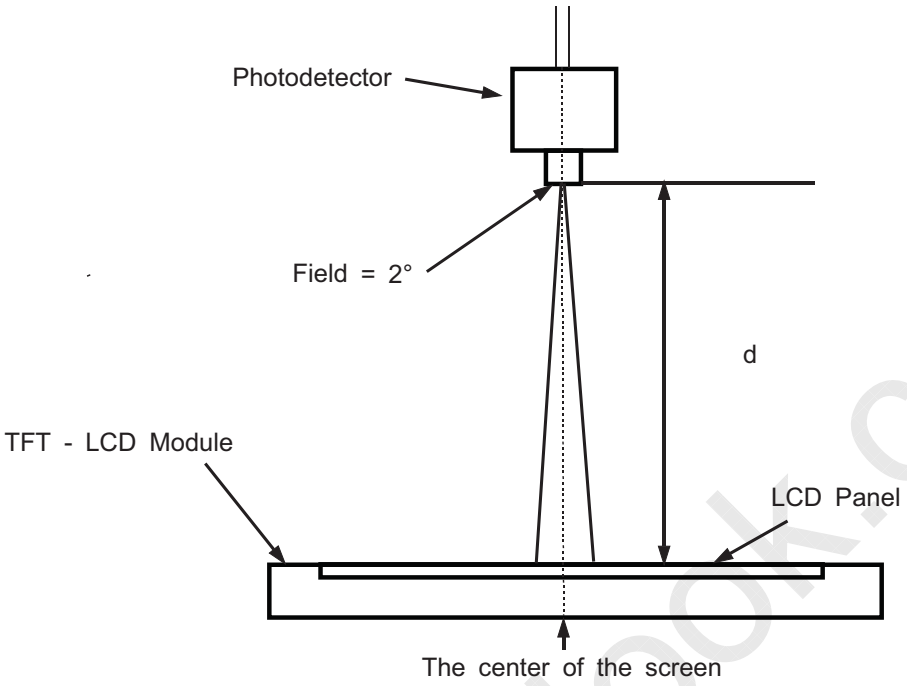
NOTE (5)

상온에서 30분 방치 후 정격에서 백라이트를 켜고 30분 후에 측정.

Photodetector : SR-3 (d = 50cm)

환경조건: 주위 온도 : 25℃±2℃

암실, 무풍(직접적인 바람제거), 무진동



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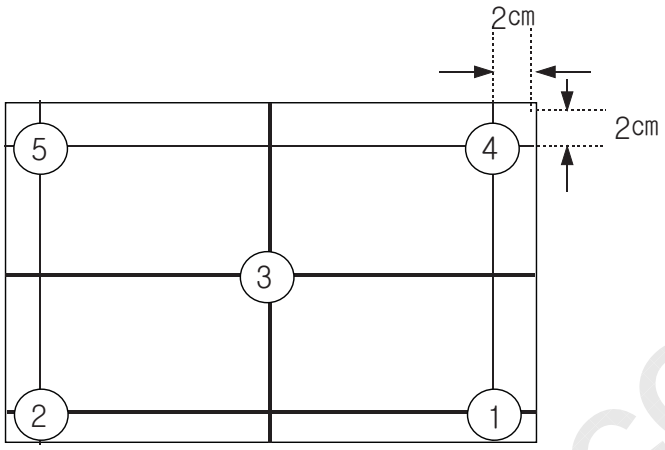
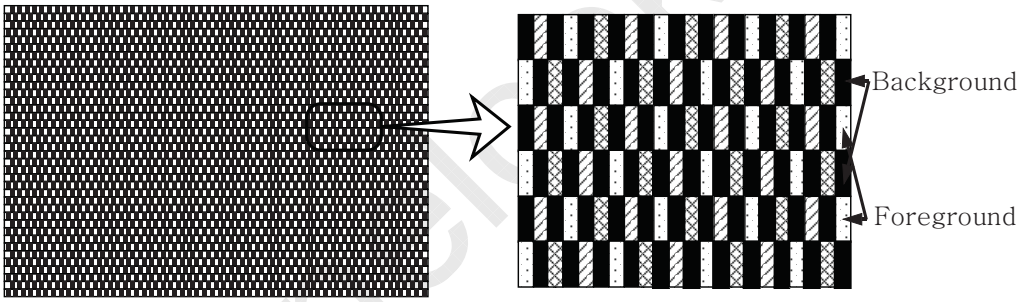
Note (6) (측정장비=RD-80S, 측정거리=50cm)
화면의 번쩍 거림(Flicker)의 정의 : LCD Panel의 화면이 깜박거리는 현상.

ⓐ 계산식은 Flicker 측정표준에 준함.

ⓑ 측정위치



ⓒ 플리커 측정 패턴 : DOT반전 구동



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8. 기구적 특성

항 목		MIN.	TYP.	MAX.	UNIT	비 고
외곽 크기	가로	359.0	359.5	360.0	mm	
	세로	223.3	223.8	224.3	mm	
무 게		-	-	440	g	
두께		-	-	3.8	mm	

NOTE 1) Thickness Measuring Method

. Measuring force : 200gf with Height Gauge

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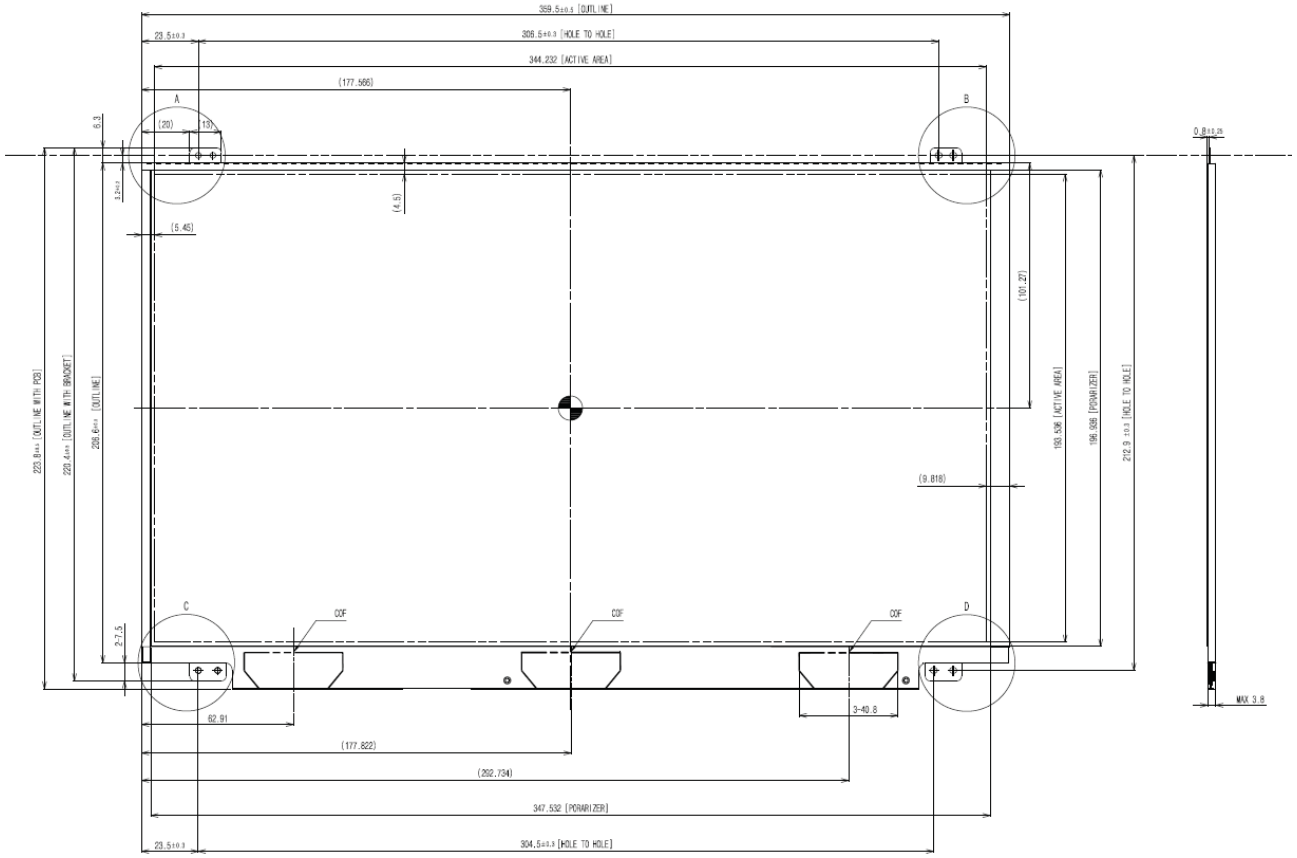
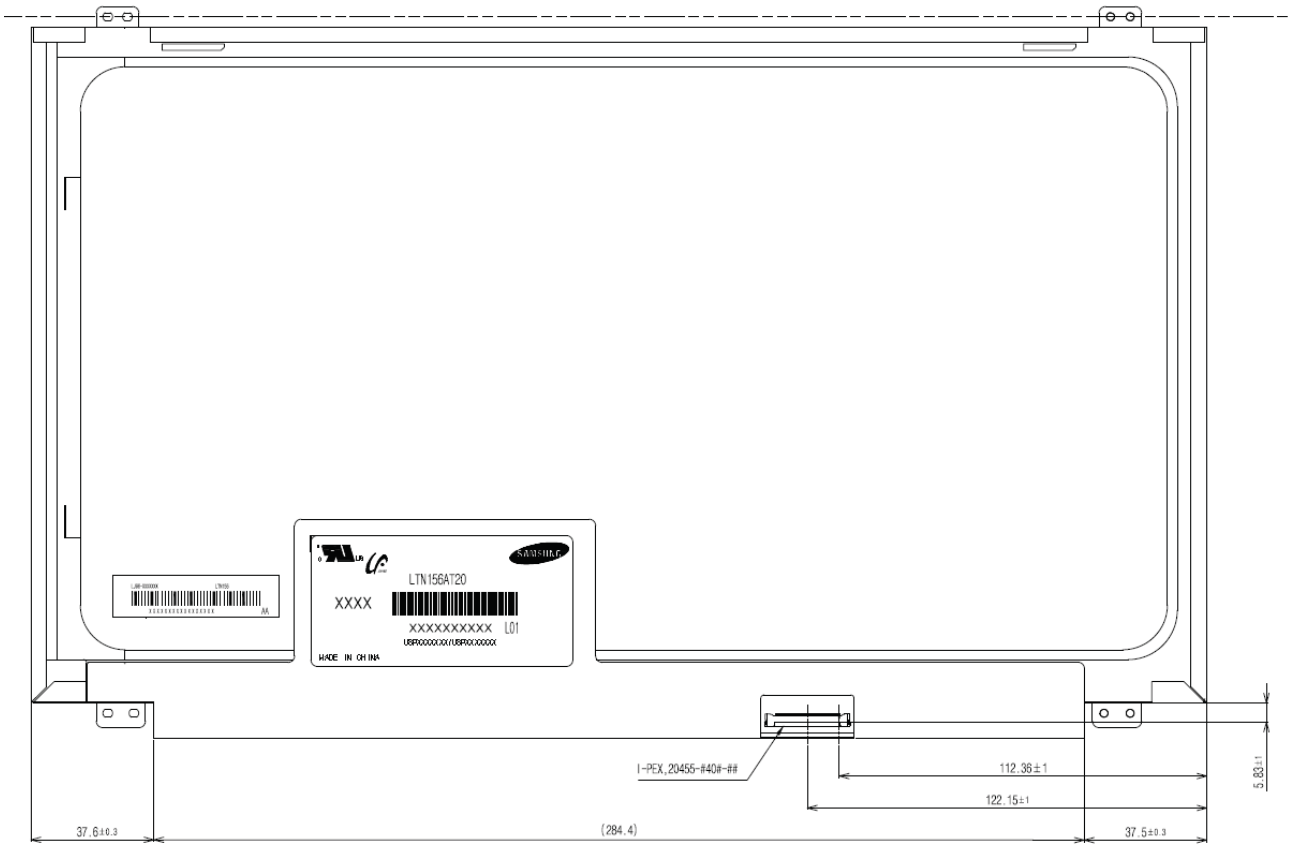
Outline Dim 도면





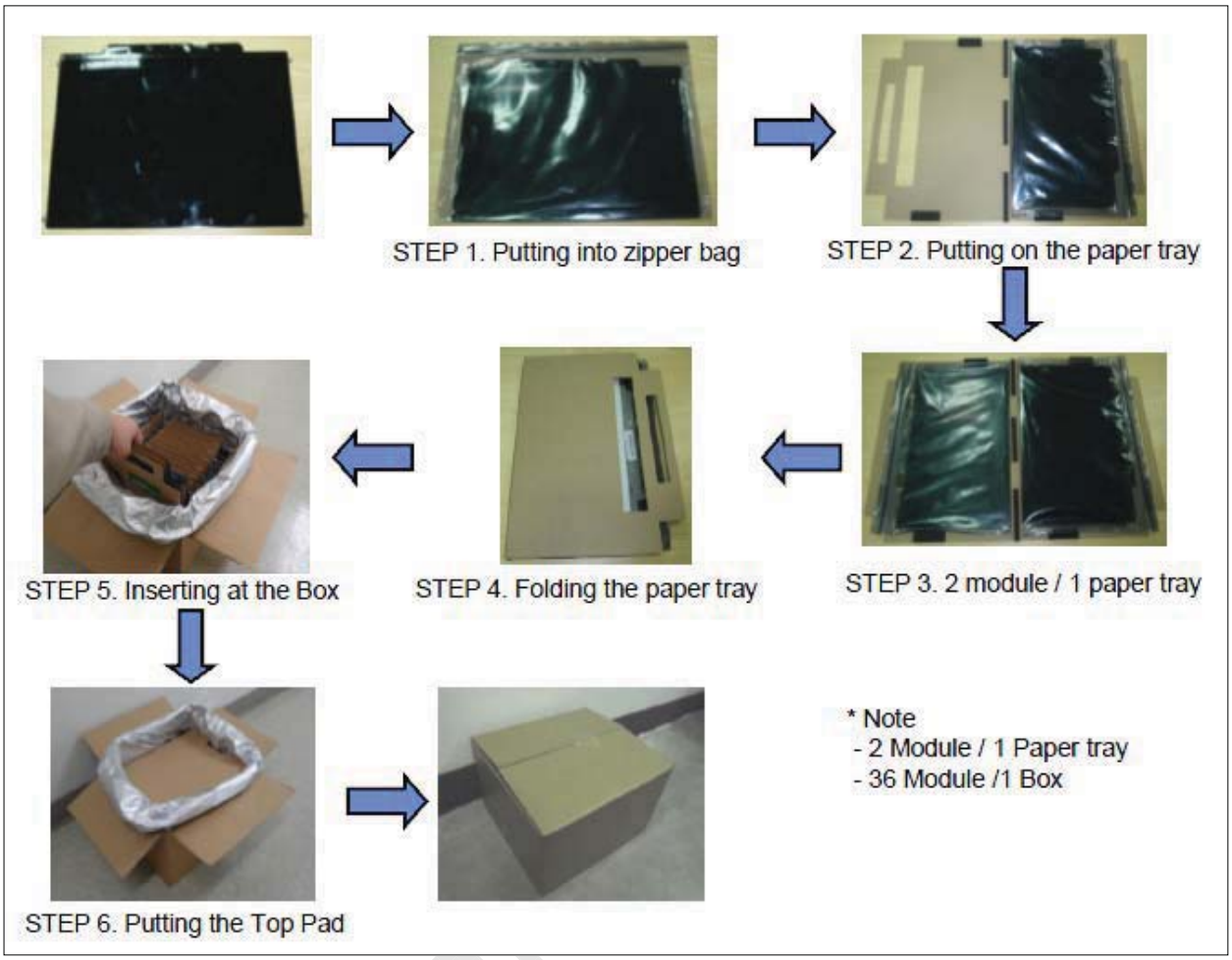
9. 포장 및 Label 사양

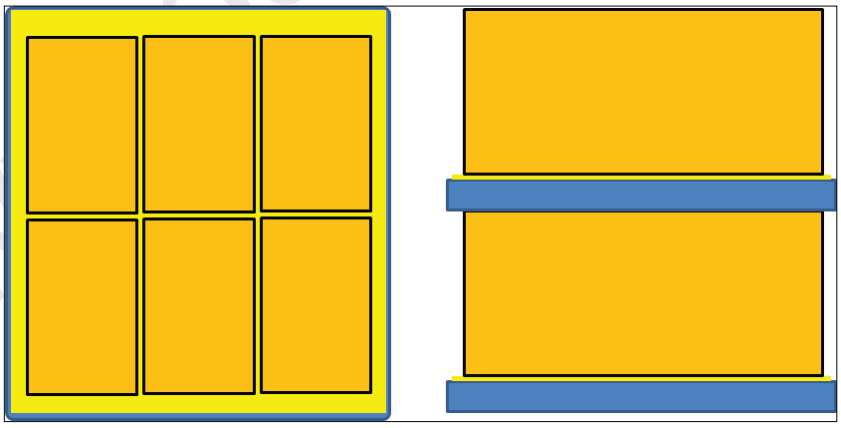
9.1 포장 사양

9.1.1 CUSHION PAD

Corrugated cardboard boxr

9.1.2 포장 방법





NOTE) 1) TOTAL : Approx.19.5 kg
2) Acceptance number of piling : 36 sets
3) Carton size : 373mm(W)*470mm(D)*327mm(H)

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9.1.3 포장 내용물

NO	품 명	비 고
1	TFT-LED Modules	36modules / 1box
2	Packing Bag	Folding
3	Silica-gel	8pcs / 1box
4	CUSHION-TRAY	2 modules / 1 tray 18 tray / 1box
5	PACKING CASE	18EA /1Pallet
6	PACKING-PALLET BOX	1EA / 1Pallet
7	PALLET-PLASTIC	1EA / 1Pallet
8	적재방법	18 Box / 1 Pallet Pallet 2단 적재
9	소박스 라벨수량	18EA / 1Pallet
10	대박스 라벨수량	4면 4EA / 1Pallet
11	소포장 무게	19.5 Kg
12	1 Pallet 포장무게	360 Kg

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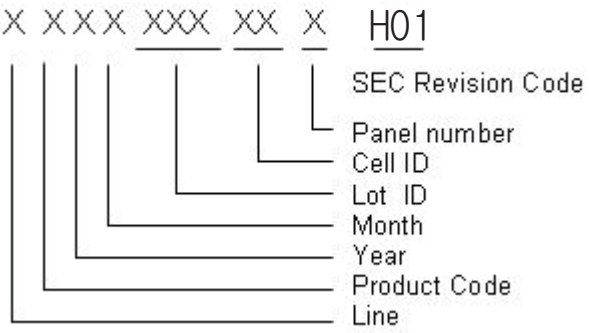
9.2 Label 사양

A nameplate bearing followed by is affixed to a shipped product at the specified location on each product.

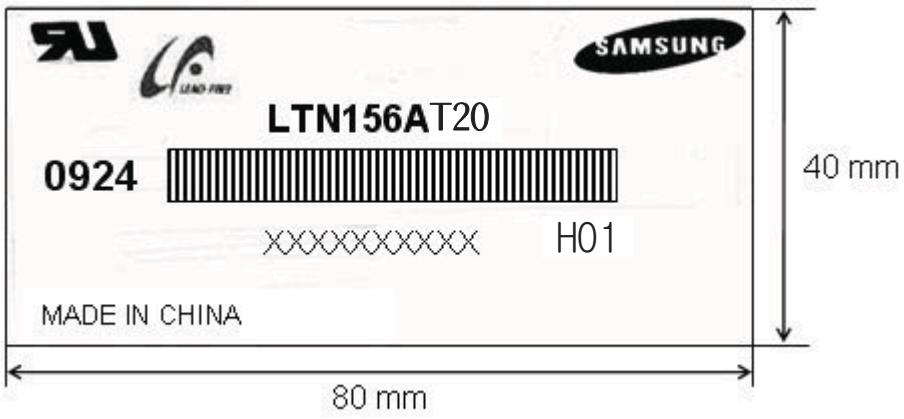
(1) Parts number : LTN156AT20-H01

(2) Revision : 3 letter

(3) Lot number :



(4) Nameplate Indication



TFT-LCD Productname: LTN156AT20
Lot number: XXXXXXXXXX
Product Revision code : H01
Inspectedwork week: 0810(2008 Year, the 10thweek)

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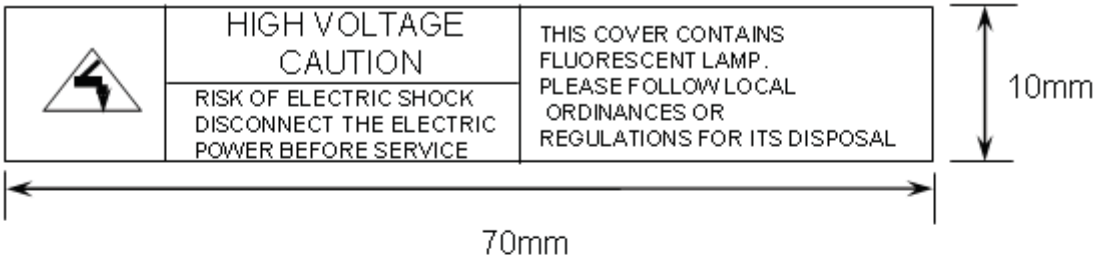
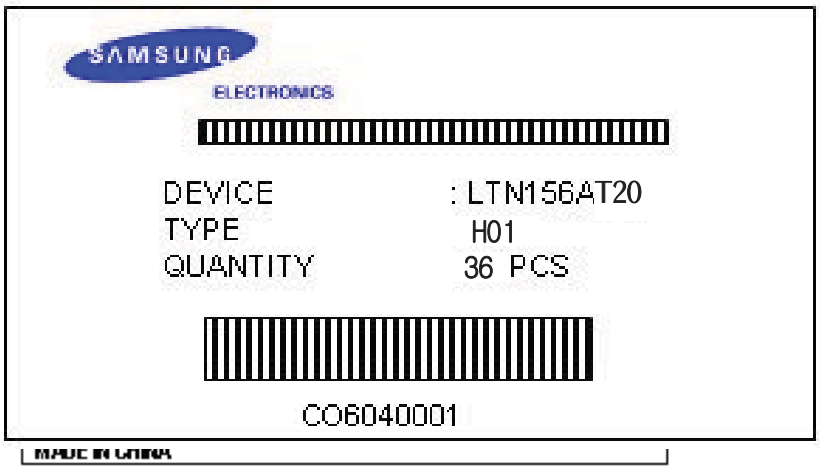
(5) High voltage caution notice



(6) Packing small box attach



(7) Packing box marking: Samsung TFT-LCD Brand Name